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Sixth Semester B.E. Degree Examination, June/July 2015
Digital Communication

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting atleast TWO questions from each part.***

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

PART – A

1 a. State sampling theorem. Write the equations for the spectrum of finite energy g(t) sampled at 1/2W sec. and g(f), if W is the highest frequency content of g(t). Sketch g(f) and sampled signal $g_s(f)$. **(08 Marks)**

b. The signal g(t) = 10 cos (20πt) cos (200πt) is sampled at the rate of 250 samples per second.
   i) Determine the spectrum of the resulting sampled signal.
   ii) Specify the cutoff frequency of the ideal reconstruction filter so as to recover g(t) from its sampled version.
   iii) What is Nyquist rate for g(t). **(04 Marks)**

c. Explain how practical sampling is different from ideal sampling. Derive an expression for the flat top sampled signal. **(08 Marks)**

2 a. Derive an expression for output SNR of the quantizer and show that $(SNR)_\theta = 6u - 7.2$ in decibels if a sinusoidal signal is quantized. **(08 Marks)**

b. Explain the need for non-uniform quantization. Also explain μ-law and A-law companding. **(07 Marks)**

c. A signal $M_1(t)$ is band limited to 3.6kHz and three other signals $M_2(t)$, $M_3(t)$ and $M_4(t)$ are band limited to 1.2 kHz. These signals are to be transmitted by means of TDM.
   i) Set up a scheme for realizing this multiplexing requirement, with each sampled signal at its Nyquist rate
   ii) What must be the speed of the commutator in samples/sec?
   iii) Determine the minimum bandwidth of the channel. **(05 Marks)**

3 a. For the given binary sequence 101000110101, draw the digital format waveform corresponding to i) ON-OFF signaling; ii) RZ bipolar signaling; iii) Manchester code; iv) NRZ polar signaling; v) NRZ bipolar signaling. **(05 Marks)**

b. What is the differences between PCM and DPCM? Briefly explain the operation of DPCM system with neat block diagram along with relevant expressions. **(08 Marks)**

c. Derive an expression for power spectral density of bipolar NRZ format and plot the same with respect to frequency. **(07 Marks)**

4 a. Explain the following terms with related equations and diagram with respect to baseband data transmission: i) ISI ii) Raised cosine spectrum. **(10 Marks)**

b. Draw and explain modified duo binary techniques. Specify how the error propagation is eliminated. **(07 Marks)**

c. A multilevel digital communication system transmits one of the sixteen possible levels over the channel every 0.8 μs.
   i) What is the minimum number of bits corresponding to each level?
   ii) What is baud rate?
   iii) What is bit rate? **(03 Marks)**

PART – B

5 a. Draw the block diagram for QPSK transmitter and receiver. From the basic principles prove that BER for QPSK is $\frac{1}{2}\text{erfc}\left(\sqrt{\frac{E_b}{N_o}}\right)$. **(10 Marks)**

b. Explain in detail along with the block diagram a coherent FSK tansmitter and receiver. **(06 Marks)**

c. The data transferred in PSK is with data rate of 1Mbps. It is desired to have $P_e \leq 10^{-4}$ with PSD at 10^{-12} N/Hz. Determine average carrier power required at the receiver input if the detector is coherent. erfc(3.5) = 0.002. **(04 Marks)**

6 a. With a conceptualized model of digital communication system, explain Gram-Schmidt orthogonalization procedure. **(10 Marks)**

b. Three signals $s_1(t)$, $s_2(t)$ and $s_3(t)$ are as shown in Fig.Q.6(b) below. Apply Gram-Schmidt procedure to obtain an orthonormal basis for signals. Express the signals $s_1(t)$, $s_2(t)$ and $s_3(t)$ in terms of orthonormal basis function. Also give the signal constellation diagram. **(10 Marks)**

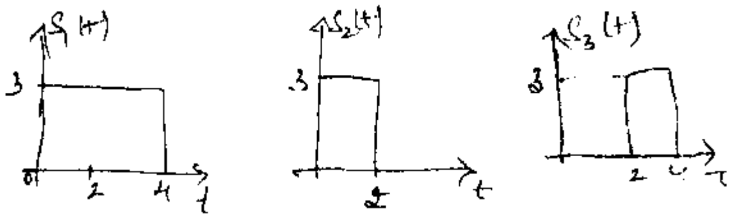

Fig.Q.6(b)

7 a. Explain the properties of matched filter. **(10 Marks)**

b. Consider a signal s(t) defined by,

$$s(t) = \begin{cases} 1 & ; \ 0 \leq t \leq T \\ 0 & ; \ \text{elsewhere} \end{cases}$$

It is proposed to approximate the matched filter for this signal by a lowpass RC filter defined by the transfer function $H(f) = \frac{1}{1 + j(f/f_o)}$, where $f_o = \frac{1}{2\pi RC}$ is the cutoff frequency of RC filter.

i) Determine optimum value of f_o for which the RC filter becomes the best approximation for matched filter.

ii) Determine the peak o/p signal to noise ratio assuming noise is AWG of zero mean and power density $N_o/2$.

iii) Determine by how many decibels the transmitted energy be increased so that the performance becomes same as that of perfectly matched filter. **(10 Marks)**

8 a. Explain the properties of maximum length sequence for a sequence generated from 3-voltage shift register with linear feedback. Verify these properties for the PN sequence 01011100101110 and also determine the period of the given PN sequence. **(08 Marks)**

b. Explain the principle of direct sequence spread spectrum system. **(05 Marks)**

c. Explain with neat block diagram the working of frequency hop transmitter and receiver. **(07 Marks)**

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